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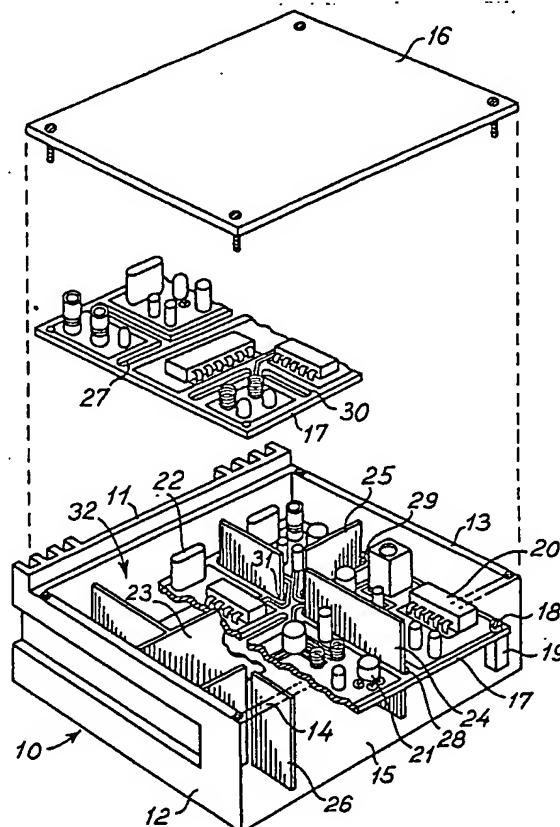
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(54) Title: AN ELECTRONIC APPARATUS OR COMPONENT AND A METHOD OF PROVIDING SUCH AN APPARATUS OR COMPONENT

(57) Abstract

An electronic apparatus comprises a housing (10) having walls (11, 12, 13, 14, 15, 16, 23, 25 and 26) of an electrically conductive material and together defining an inner space (32). The walls of the housing comprise outer walls (11-15), and partition walls (23-26) extending from one of the walls (15) of the housing into the inner space (32) of the housing dividing the inner space into different compartments. The apparatus further comprises an electronic circuit board (17) having electronic components (20, 21 and 22) mounted thereon and being provided with apertures (27, 28, 29 and 30) through which the partition walls extend shielding the individual compartments and the electronic circuits contained within the individual compartments from each other. The outer walls of the housing further shield the electronic circuits of the apparatus from the environment or the surroundings.



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WO 86/01969

PCT/DK85/00089

1

"An electronic apparatus or component and a method of providing such an apparatus or component".

- 5 The present invention relates to the electronic field. More specifically, a first aspect of the present invention relates to an electronic apparatus comprising a housing having walls of an electrically conductive material and together defining an inner space of the housing.

- 10 Within the electronic industry, different kinds of electronic apparatuses of the above type are provided. Within particular fields of the electronic industry, electronic apparatus are provided in which various electronic circuits are included which require shielding from one another and from the environment or surroundings. An example of such a field is the telecommunication field. In the commonly employed shielding technique the individual electronic circuits are shielded from each other and from the environment or surroundings in individual metallic encasings. In one embodiment of this circuit encasing technique, the individual electronic circuits are provided on separate circuit boards, such as printed circuit boards, e.g. single or double-sided printed circuit boards, which are enclosed within individual metallic encasings or housings. However, as the electronic industry is moving towards a miniaturizing of the electronic circuits, involving the technique of providing integrated circuits and further involving the well-known layer techniques, including thick-film technique and thin-film technique, the provision of the individual electronic circuits to be shielded from one another and from the environment or surroundings on separate circuit boards and arranging the individual circuit boards within individual metallic encasings is considered to be an irrational technique which to a great deal counteracts the miniaturizing and integration trend.
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In order to solve the problem of combining the miniaturizing and integration technique and the shielding requirements of the electronic circuits which are to be shielded, it has been attempted to arrange

WO 86/01969

PCT/DK85/00089

2

the electronic components together constituting the electronic circuits of the apparatus on a single circuit board and to provide shielding of individual electronic circuits in relation to one another and in relation to the environment or surroundings.

- 5 In Swedish patent No. 75 108 00-1 one of these attempts is disclosed, including the provision of shielding plates which are soldered on to the circuit board together with the electronic component and which together define compartments in which the individual electronic circuits are encased. The circuit board including the electronic components and the shielding plates is arranged within the inner space of the apparatus housing which serves the purpose of shielding the electronic circuit in relation to the environment or surroundings. However, this technique is not quite satisfactory since the technique involves the provision of a great number of individual components, viz. the individual shielding plate, which are to be mounted and soldered on to the circuit board. Furthermore, the shielding plates have to provide galvanic contact with the apparatus housing and, consequently, contact means serving the purpose of establishing contact between the shielding plates and the apparatus housing has to be provided.

- A further problem relating to the technique of providing separate shielding plates soldered on to the circuit board and encasing the electronic circuits also mounted thereon originates from the trend to mount more and more components on the circuit board by arranging components on both sides thereof and soldering the components on to the circuit board in automatized processes such as dip soldering processes or wave soldering processes in which the entire circuit board having all components arranged on both sides thereof is soldered. When employing these automatized soldering processes, the above shielding plates have to be arranged on the side of the circuit board opposite to the side from which the solder is supplied as the individual compartments defined by the shielding plates would be filled out with solder in case it is attempted to supply solder to the side of the circuit board on which the shielding plates are mounted.

WO 86/01969

PCT/DK85/00089

3

In another attempt to combine the miniaturizing and integration of the electronic circuits and the shielding of the individual electronic circuits described in US Patent No. 4,370,700, it has been suggested to provide a housing having integrally formed perpendicular walls extending outwardly from the housing into the inner space thereof and to arrange the printed circuit board in abutting engagement with the perpendicularly extending walls so that the circuit board is positioned parallel with the base of the housing and the perpendicularly extending walls encircle the circuits which are located on the board and which are to be shielded.

Although this well-known technique eliminates some of the major disadvantages of the above described technique involving the provision of individual shielding plates soldered on to the circuit, viz. reduces the number of components, this technique still suffers from several severe drawbacks. First of all as the shielding effect is highly dependent on the close abutting arrangement of the circuit board relative to the perpendicularly extending walls. Even a minor gap between the outer side surface of the circuit board and the perpendicularly extending wall of the housing may cause deteriorating leakage which to a great extent reduces the desired shielding effect. Furthermore, as the shielding walls are arranged on one side of the circuit board exclusively, the shielding effect is reduced as compared to the technique involving individual encasings enclosing the individual electronic circuits to be shielded.

Therefore, it is an object of the present invention to provide an apparatus of the above described type in which a single electronic circuit board including the electronic circuits is provided and in which the electronic circuits to be shielded from one another are effectively shielded from each other and from the environment or surroundings.

This object is obtained in an electronic apparatus according to the invention comprising a housing having walls of an electrically conductive material and together defining an inner space of the housing, and an electronic circuit board arranged within said inner space and

WO 86/01969

PCT/DK85/00089

4

- including at least two electronic circuits located at different sections of the circuit board, the circuit board further being provided with at least one aperture separating said sections from each other, and the walls of the housing comprising outer walls and at least one partition wall extending from one of said outer walls into the inner space of the housing and through the aperture of the circuit board, so as to substantially divide the inner space of the housing into mutually shielded compartments each containing one of said sections of the circuit board.
- 10 Although the individual electronic circuits located at different sections of the circuit board may be totally independent of each other and operate independently of each other, the teaching of the present invention renders it possible to provide said at least two circuits adapted to cooperate electronically, and to provide the electronic
- 15 circuit board provided with a circuit interconnecting said sections of the circuit board, as the shielding of the electronic circuit is accomplished by the partition wall extending through the aperture of the circuit board.
- 20 The teaching of the present invention may be combined with any of the well-known circuit board techniques, including printed circuit boards, either single-sided or double-sided printed circuit boards, multi-layer printed circuit boards and layer techniques, such as thin-layer technique and thick-layer technique, involving the provision of the circuit board as a thick-film substrate.
- 25 The partition wall which in accordance with the principles of the present invention extends from one of the outer walls of the housing into the inner space of the housing may be constituted by a separate wall component which is either removably or fixedly fastened to the inner surface of the said one outer wall. However, in accordance with
- 30 the presently preferred embodiment of the invention, the partition wall is an integral part of the said outer wall of the housing. By providing the partition wall as an integral part, it is rendered possible to provide the said outer wall of the housing together with the partition wall or the partition walls in a single production
- 35 process, such as a drawing, casting or pouring process.

WO 86/01969

PCT/DK85/00089

5

Since the partition wall is conventionally of a plate configuration, said at least one aperture may preferably be of a substantially elongated configuration or composed of segments of a substantially elongated configuration adapted to said plate configuration of the partition wall.

- 5 In accordance with the preferred embodiment of the apparatus according to the invention, the walls of the housing are of substantially rectangular configurations. In this preferred embodiment of the apparatus according to the invention, the house may be provided with generally parallel top and base walls, the circuit board may be arranged generally parallel to said top and base walls, the said one outer wall of the housing may be the base wall of the housing, and said at least one partition wall may extend generally perpendicularly from the base wall to the top wall of the housing.

- 10 Although the circuit board may obviously be mounted and fastened to any of the outer walls of the housing in any appropriate manner, e.g. by means of conventional fastening means, such as screws, bolts etc., i.e. fastened to the top, side, front or rear wall of the housing, the circuit board is preferably mounted on and fastened to the base wall of the housing, and the top wall is a removable wall providing direct access to the circuit board when removed from the housing.

- 15 Another aspect of the present invention relates to an electronic component in which the shielding technique of the present invention is employed. The electronic component according to the invention comprises a housing having walls of an electrically conductive material and together defining an inner space of the housing, and an electronic circuit board arranged within said inner space and including at least two electric circuits located at different sections of the circuit board, the circuit board further being provided with at least one aperture separating said sections from each other, and the walls of the housing comprising outer walls and at least one partition wall extending from one of said outer walls of the housing into the inner space of the housing and through the aperture of the circuit board, so as to substantially divide the inner space of the housing into

WO 86/01969

PCT/DK85/00089

6

mutually shielded compartments each containing one of said sections of the circuit board. The electronic component according to the invention may be of any configuration, e.g. included in any of the conventional electronic component packages or may constitute a subcomponent or
5 subapparatus of a main apparatus.

The electronic component according to the invention may further include any of the above described characteristics of the apparatus according to the invention and may further have the inner space of the housing filled with an electrically insulating casting as is con-
10 ventional in the art and serving the well-known mechanical fixation, insulation and impenetration purposes.

A further aspect of the present invention relates to a method providing an electronic apparatus or an electronic component including at least two electronic circuits, comprising:

- 15 providing a housing having walls of an electrically conductive material and together defining an inner space of the housing, at least a part of one of the walls of the housing being removable so as to provide an opening to the inner space of the housing, and the walls of the housing comprising outer walls and at least one partition wall extend-
20 ing from one of the outer walls of the housing into the inner space of the housing substantially dividing the inner space of the housing into at least two compartments,
- providing an electronic circuit board having at least one aperture and including said at least two electronic circuits located at different
25 sections of the circuit board, said at least one aperture separating said sections from each other,
- introducing the circuit board into the inner space of the housing through the opening thereto,
- arranging the circuit board in the inner space of the housing so as to
30 make said at least one partition wall of the housing extend through said at least one aperture of the circuit board in order to arrange said sections of the circuit board in said compartments of the inner space of the housing so as to mutually shield said compartments and said sections arranged therein from each other, and

WO 86/01969

PCT/DK85/00089

7

arranging said at least part of one wall of the housing thereon so as to shield said sections of the circuit board from the environment or the surroundings.

5 The invention will now be further described with reference to the drawing, on which a perspective, partially cut-away view of a preferred embodiment of an apparatus according to the invention is shown.

10 In the drawing, an apparatus housing designated 10 in its entirety is shown. The housing 10 comprises a rear wall 11 which further constitutes a heat sink of the apparatus and is provided with protruding heat radiating fins, side walls 12 and 13, a front wall 14 which is partially shown in dotted line, a base wall 15, and a detachable cover 16 constituting the top wall of the housing. The outer walls 11-16 of the apparatus housing 10 defines an inner space 32 of the housing.

15 Within the inner space 32, a printed circuit board 17 is arranged. As is evident from the drawing, the printed circuit board 17 is fastened to the base wall 15 of the apparatus housing by means of screws, one of which is shown on the drawing and designated the reference numeral 18, and distance pieces, one of which is shown on the drawing

20 and designated the reference numeral 19.

On the upper side surface of the printed circuit board 17 electronic components, including an integrated circuit designated 20, a transistor designated 21, and a capacitor 22, are arranged and soldered on to circuit tracks of the printed circuit board. Apart from the

25 electronic components arranged on the upper side surface of the printed circuit board 17, the printed circuit board may in accordance with the teaching of the present invention further be provided with electronic components arranged on the lower side surface of the printed circuit board.

30 As will be understood, the apparatus housing 10 shields the electronic circuits of the electronic apparatus from the environments or the surroundings. However, the individual circuits of the apparatus which are located at different sections of the printed circuit board 17, may

WO 86/01969

PCT/DK85/00089

8

- further require shielding from each other. This shielding of the individual electronic circuits from each other is in accordance with the principles of the present invention provided by means of partition walls, four of which are designated the reference numerals 23-26, and which extend generally perpendicularly from the base wall 15 of the apparatus housing 10 into the inner space 32 thereof. As is evident from the drawing, the partition walls 23-26 extend to such a height that the upper edges of the partition walls are brought into contact with the lower side surface of the detachable cover 16 when the cover is mounted on top of the apparatus housing. The circuit board 17 is provided with apertures through which the partition walls extend and four of which are designated the reference numerals 27-30. As is evident from the drawing, the apertures are basically of an elongated configuration and further provide areas of the circuit board interconnecting the individual sections thereof first of all serving the purpose of mechanically keeping the entire circuit board together and further serving the purpose of providing electrical connection between the individual sections of the circuit board as illustrated by a circuit track 31.
- 20 It is to be understood, that numerous modifications are possible and obvious to the skilled art worker and are to be included within the scope of the appending claims.

WO 86/01969

PCT/DK85/00089

9

CLAIMS

1. An electronic apparatus comprising a housing having walls of an electrically conductive material and together defining an inner space of the housing, and an electronic circuit board arranged within said inner space and including at least two electronic circuits located at different sections of the circuit board, the circuit board further being provided with at least one aperture separating said sections from each other, and the walls of the housing comprising outer walls and at least one partition wall extending from one of said outer walls into the inner space of the housing and through the aperture of the circuit board, so as to substantially divide the inner space of the housing into mutually shielded compartments each containing one of said sections of the circuit board.
2. An apparatus according to claim 1, said at least two circuits being adapted to electronically cooperate, and the electronic circuit board being provided with a circuit interconnecting said sections of the circuit board.
3. An apparatus according to claim 1 or 2, the circuit board being a printed circuit board.
4. An apparatus according to claim 3, the printed circuit board being a double-sided printed circuit board.
5. An apparatus according to claim 3, the printed circuit board being a multi-layer printed circuit board.
6. An apparatus according to claim 1 or 2, the circuit board being a thick-film substrate.
7. An apparatus according to any of the preceding claims, the partition wall being an integral part of the said outer wall of the housing.
8. An apparatus according to any of the preceding claims, said at least one aperture being of a substantially elongated configuration or composed of segments of substantially elongated configurations.

WO 86/01969

PCT/DK85/00089

10

9. An apparatus according to any of the preceding claims, the walls of the housing being of substantially rectangular configurations.
10. An apparatus according to claim 9, the housing being provided with generally parallel top and base walls, the circuit board being
5 arranged generally parallel to said top and base walls, the said one outer wall of the housing being the base wall of the housing, and said at least one partition wall extending generally perpendicularly from the base wall to the top wall of the housing.
11. An apparatus according to claim 10, the circuit board being
10 mounted on and fastened to the base wall of the housing, and the top wall being removable.
12. An electronic component comprising a housing having walls of an electrically conductive material and together defining an inner space of the housing, and an electronic circuit board arranged within said
15 inner space and including at least two electric circuits located at different sections of the circuit board, the circuit board further being provided with at least one aperture separating said sections from each other, and the walls of the housing comprising outer walls and at least one partition wall extending from one of said outer walls
20 of the housing into the inner space of the housing and through the aperture of the circuit board, so as to substantially divide the inner space of the housing into mutually shielded compartments each containing one of said sections of the circuit board.
13. An electronic component according to claim 12, said at least two
25 circuits being adapted to electronically cooperate, and the electronic circuit board being provided with a circuit interconnecting said sections of the circuit board.
14. An electronic component according to claim 12 or 13, the circuit board being a thick-film substrate.
15. An electronic component according to any of the claims 12-14, the
30 partition wall being an integral part of the said outer wall of the housing.

WO 86/01969

PCT/DK85/00089

11

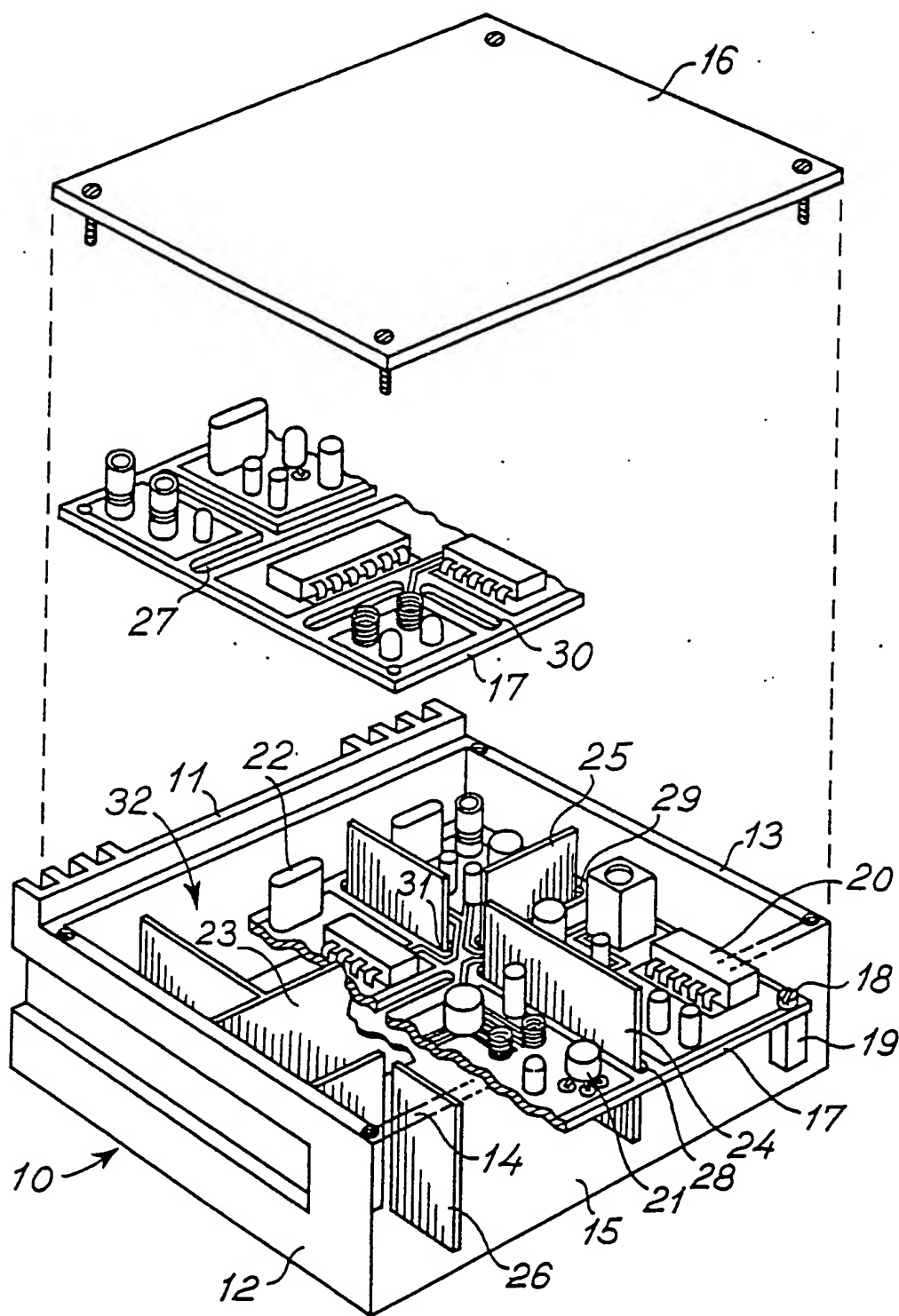
16. An electronic component according to any of the claims 12-15, the inner space of the housing being filled with an electrically insulating casting.

17. A method of providing an electronic apparatus or an electronic component including at least two electronic circuits, comprising:
- 5 providing a housing having walls of an electrically conductive material and together defining an inner space of the housing, at least a part of one of the walls of the housing being removable so as to provide an opening to the inner space of the housing, and the walls of the
- 10 housing comprising outer walls and at least one partition wall extending from one of the outer walls of the housing into the inner space of the housing substantially dividing the inner space of the housing into at least two compartments,
- 15 providing an electronic circuit board having at least one aperture and including said at least two electronic circuits located at different sections of the circuit board, said at least one aperture separating said sections from each other,
- introducing the circuit board into the inner space of the housing through the opening thereto,
- 20 arranging the circuit board in the inner space of the housing so as to make said at least one partition wall of the housing extend through said at least one aperture of the circuit board in order to arrange said sections of the circuit board in said compartments of the inner space of the housing so as to mutually shield said compartments and
- 25 said sections arranged therein from each other, and
- arranging said at least part of one wall of the housing thereon so as to shield said sections of the circuit board from the environment or the surroundings.

WO 86/01969

PCT/DK85/00089

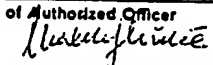
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INTERNATIONAL SEARCH REPORT

International Application No

PCT/DK85/00089

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC 4		
H 05 K 9/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ?		
Classification System	Classification Symbols	
IPC 4	H 05 K 9/00; H 04 B 15/02; G 12 B 17/02	
Nat Cl	21a ⁴ :22/05; 21a ⁴ :76	
US Cl	174:35; 361:424; 333:79	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
P	DE, A1, 3 445 161 (ALPSELECTRIC CO.) 20 June 1985	1-17
P	DE, A1, 3 447 347 (ALPS ELECTRIC CO.) 11 July 1985	1-17
X	GB, A, 2 123 216 (FERRANTI PLC.) 25 January 1984 Especially figure 2 and 3 & DE, 3321320 SE, 8303488	1-17
X	SE, B, 391 105 (TELEFON AB LM ERICSSON) 31 January 1977	1-17
X	US, A, 4 370 700 (DUDDLES ET AL) 25 January 1983	1-17
A	GB, A, 2 101 811 (RACAL-DANA INSTRUMENTS LTD) 19 January 1983 Especially figure 2 and 4) .../...	1-17
<p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1985-11-19	1985-11-26	
International Searching Authority	Signature of Authorized Officer	
Swedish Patent Office	 Sven-Olof Wirlée	

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PCT/DK85/00089

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 3 721 746 (KNAPPENBERGER) 20 March 1973 Especially figure 4	1-17
A	US, A, 3 816 911 (KNAPPENBERGER) 18 June 1974 Especially figure 4	1-17